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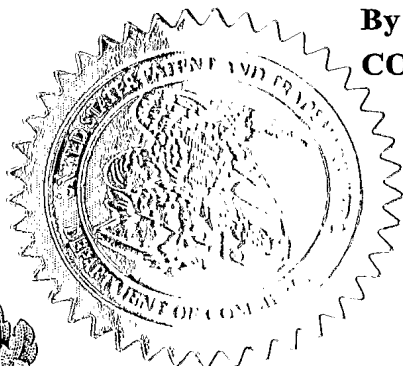
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**PROVISIONAL APPLICATION FOR PATENT COVER SHEET**

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)					
Given Name (first and middle (if any))	Family Name or Surname	Residence (City and either State or Foreign Country)			
Moshe Shalom Shlomo	MALIK LEVIN NEVO	Carmiel, Israel Afulit, Israel Tel-Aviv, Israel			
<input type="checkbox"/> Additional inventors are being named on the _____ separately numbered sheets attached hereto					
<b>TITLE OF THE INVENTION (280 characters max)</b>					
HAND-HELD FOAM DISPENSER					
<div style="display: flex; justify-content: space-between;"> <div>           Direct all correspondence to:  <input type="checkbox"/> Customer Number <span style="border: 1px solid black; display: inline-block; width: 150px; height: 1.2em; vertical-align: middle;"></span>            OR  <input checked="" type="checkbox"/> Firm or Individual Name         </div> <div> <b>CORRESPONDENCE ADDRESS</b>            Roy N. Envall, Jr.            c/o Anthony Castorina            2001 Jefferson Davis Highway, Suite 207            Arlington, VA 22202            U.S.A. Telephone (703) 415-1581 Fax (703) 415-4864         </div> </div>					
<div style="border: 1px solid black; padding: 5px; text-align: center;">             Place Customer Number Bar Code Label here           </div>					
<b>ENCLOSED APPLICATION PARTS (check all that apply)</b> <input checked="" type="checkbox"/> Specification Number of Pages <span style="border: 1px solid black; display: inline-block; width: 40px; text-align: center;">21</span> <input type="checkbox"/> CD(s), Number <span style="border: 1px solid black; display: inline-block; width: 60px; height: 1.2em; vertical-align: middle;"></span> <input checked="" type="checkbox"/> Drawing(s) Number of Sheets <span style="border: 1px solid black; display: inline-block; width: 40px; text-align: center;">9</span> <input type="checkbox"/> Other (specify) <span style="border: 1px solid black; display: inline-block; width: 150px; height: 1.2em; vertical-align: middle;"></span> <input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76					
<b>METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)</b> <input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. <input type="checkbox"/> A check or money order is enclosed to cover the filing fees. <input checked="" type="checkbox"/> The Director is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number <span style="border: 1px solid black; display: inline-block; width: 100px; text-align: center;">03-3419</span> <input type="checkbox"/> Payment by credit card. Form PTO-2036 is attached.					
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government. <input checked="" type="checkbox"/> No. <input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are: _____					

Respectfully submitted,

SIGNATURE

*Paul Fenster*

Date

3/29/2004

TYPED or PRINTED NAME

Paul Fenster

REGISTRATION NO.

33,877

(if appropriate)

Docket Number:

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TELEPHONE

(703) 415-1581

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**APPLICANT:** Moshe MALIK et al.

**DOCKET NO.:** 416/03802

**FOR:** HAND-HELD FOAM DISPENSER

**FILED:** HERewith

**SERIAL NO:**

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Receipt of the following provisional application papers is evidenced hereon  
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Application including 21 pages of specification, 37 claims, 9 sheets of drawings,  
Transmittal letter including duplicate charge sheet authorizing charge against Deposit  
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**HAND-HELD FOAM DISPENSER****FIELD OF THE INVENTION**

The present invention relates to foam dispensers and particularly to hand held foam dispensers.

5

**BACKGROUND OF THE INVENTION**

Foam materials are commonly used for packaging. The foam is generally generated by mixing two chemical components, which harden within about 10-30 seconds. In many cases, a foam dispensing gun is used to generate the foam at the packaging site. U.S. patent 4,262,848 to Chabria and U.S. patent 5,462,204 to Finn, the disclosures of which are incorporated herein by reference, describe such guns which are connected through tubes to large containers including the chemicals used in forming the foam. The dispensing gun generally includes a pair of pumps which suck the chemicals out of the containers at precise required amounts in order to achieve a proper mix. In addition, the chemicals may be heated in order to achieve a better mix reaction.

15

U.S. patent 3,178,157 to Cole, the disclosure of which is incorporated herein by reference, describes a compact foaming apparatus for various tasks, such as inflating a raft. The foaming apparatus includes two tanks which receive flexible bags that carry the chemicals to be mixed in forming the foam. A pressure source is used to compress the bags and cause the chemicals to leave the bags.

20

U.S. patent 6,691,898 to Hurray et al., the disclosure of which is incorporated herein by reference, describes a hand-held dispensing apparatus for urethane foams, which is claimed to allow one handed operation. The apparatus includes a pen-shaped dispenser connected through tubes to a pair of chemical containing pressurized containers. A button on the pen-shaped dispenser is used to actuate release of the chemicals from the pressurized containers.

25

U.S. patent 5,348,392 to Bouquet et al., the disclosure of which is incorporated herein by reference, describes a hand-held apparatus for mixing two chemicals from two separate receptacles. The apparatus includes piercing means for piercing the receptacles, a mixing chamber and a passageway for expelling the foam. The apparatus is used for medical purposes and is actuated by direct mechanical pressure of a user.

30

The above hand-held apparatus are generally inaccurate in the proportions of chemicals they mix and provide a low quality foam mix.

As foam materials harden within a short time, remnants of the foam may harden within the dispensing apparatus and clog flow passageways.

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U.S. patent 6,079,868 to Rydell, describes a hand-held device for mixing and delivering a curable biomaterial in a minimally invasive medical procedure. In one embodiment, the device pumps the chemicals it mixes from remote containers connected through tubes to the device. In another embodiment, the device has medical containers  
5 mounted on it and the chemicals are extracted using pressure. The materials used for generating foam are different from those used in biomedical applications. In addition, a delivery conduit is required in medical applications but not in packaging applications. The Rydell device uses a relatively long static mixer for mixing the chemicals, which needs to be replaced after every use.

10

### SUMMARY OF THE INVENTION

A general aspect of some embodiments of the invention relates to a compact foam dispensing device, which provides high quality foam mixing. The dispensing device optionally allows intermittent use in small amounts over a relatively long period, with reduced waste and element replacement costs. Optionally, the compact dispensing device is hand-held, along with  
15 internal foam chemical containers.

An aspect of some embodiments of the invention relates to a hand-held dispensing device for generating foam, which pumps the chemicals used in generating the foam out of chemical containers included in the hand-held device. Pumping (referred to herein also as sucking) the chemicals out of their containers allows more accurate control of the mixed  
20 quantities, than pushing the chemicals out of their containers. In some embodiments of the invention, the pumping provides accurate chemical amounts with an error of up to about 2-5% of the pumped amount, or even less. Pumping the chemicals also allows easily reaching high pressure levels, which can be used for high quality mixing of the chemicals. Furthermore, using pumping reduces the amount of chemical remnants settling along the chemical paths in  
25 the dispensing device. In some embodiments of the invention, a pushing mechanism is used in addition to the pumping. The pushing mechanism optionally provides a coarse force applied to the chemicals, while the pumping provides the accurate control of the ejection.

In some embodiments of the invention, the hand-held dispensing device includes a heating mechanism, which heats the chemicals used in generating foam, to an optimal  
30 temperature level for the foam creation.

Optionally, the hand-held dispensing device can be held and operated with one hand. In some embodiments of the invention, the device is worn on the user's hand and/or includes a support structure for placing the dispensing device on the user's arm. The device is optionally

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light weight, for example having a weight of less than 5 kilograms including the chemical containers mounted in the device. Optionally, when using small chemical containers, the dispensing device including the chemical containers has a weight of less than 3 kilograms or even 2 kilograms. In some embodiments of the invention, the device has small dimensions,  
5 optionally having a longest dimension of less than 40-60 centimeters or even shorter.

In some embodiments of the invention, the device includes substantially closed compartments which receive the chemical containers, such that during use the chemical containers are not seen by the user. Optionally, the closed compartments are adapted to receive containers of different sizes, for example by limiting the number of sides of the compartments  
10 to which the chemical containers are connected. In some embodiments of the invention, the chemical containers connect only to a single side of the compartments in which they reside. Alternatively to including the chemical containers in closed compartments, the chemical containers are mounted externally on the dispensing device. In some embodiments of the invention, the device does not include tubes that are external to a housing of the device. Thus,  
15 there is no need to drag tubes and/or no need to be careful from external tubes getting stuck on bulging objects. Furthermore, having very short internal tubes, if at all, reduces the chances of tubes getting clogged.

The chemical containers are optionally rigid, so that their handling is simpler than the handling of bags. Optionally, the bottom of the container is movable, to allow pushing the  
20 contents of the container toward an outlet from which the chemical is pumped.

The device is optionally formed of a long-term core and one or more short term replaceable parts. Optionally, only the replaceable parts come in contact with the chemicals after they are mixed. Optionally, the replaceable parts are easily removed by a customer without requiring tools or application of a large force. In some embodiments of the invention,  
25 the replaceable parts can be replaced by the user using only a single hand.

An aspect of some embodiments of the invention relates to a hand-held dispensing device for generating foam, which has a detachable portion in which the chemicals forming the foam mix together. The detachable portion allows fast replacement of elements of the dispensing device that were clogged by settling foam. Optionally, a single detachable portion  
30 of the dispensing device includes all the elements of the device that come in contact with the chemicals after they are mixed and/or on which hardened foam remnants may settle. The remaining parts of the dispensing device are optionally designed for long term use. Optionally,

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the remaining parts include relatively expensive elements, such as a heater, a motor and/or electronic circuits.

5 An aspect of some embodiments of the invention relates to a dispensing device for generating foam, which has an elastic mixing chamber. When the dispensing device is not operative, the mixing chamber is in a compressed state, such that foam remnants cannot harden within the chamber and clog the dispensing device, or at least the amount of foam hardening in the mixing chamber is minimized. In operation, the pressure of the provided chemical streams expands the mixing chamber to a size suitable for a high quality mix of the foam components. Alternatively or additionally, the flexibility of the mixing chamber allows a user to press the  
10 mixing chamber and easily release settled foam remnants.

An aspect of some embodiments of the invention relates to a foam dispensing device having a durable and flexible nozzle. The nozzle is sufficiently flexible to allow its compression in order to remove foam that settled in the nozzle, while being sufficiently durable to be usable after the compression. Optionally, the nozzle is formed of a smooth  
15 material to which the foam does not attach strongly, such as Teflon, delarin or polypropylene. In pressing on the nozzle, settling foam detaches from the nozzle.

An aspect of some embodiments of the invention relates to a foam dispensing device in which the mixing of the foam components is performed in a flared mixing chamber having a larger opening to the environment than to the sources of the components together. In some  
20 embodiments of the invention, the opening to the environment is larger than 10% or even 30% of the outer surface of the chamber. Optionally, the chamber has a conic shape, receiving the foam through a narrow end of the cone and having an opening to the environment at the wide end of the chamber. The use of a mixing chamber having a large opening to the environment allows relatively easy removal of foam remnants that hardened in the mixing chamber.

25 The foam dispensing device of this and the following aspect may be a hand-held device with chemical containers mounted thereon, or may be a device which receives chemicals from remote containers, via tubes.

An aspect of some embodiments of the invention relates to a heating base for storing and pre-heating chemical containers used in generating foam. The heating base optionally pre-  
30 heats the containers so that the time required to warm the tubes within a dispensing gun is short. In some embodiments of the invention, the heating base also has a receptacle adapted to receive the dispensing gun.



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There is therefore provided in accordance with some embodiments of the invention a foam dispensing device, comprising a casing, a port adapted to receive one or more containers including a plurality of chemicals in a plurality of compartments; and a suction unit adapted to pump the chemicals from the compartments and direct the chemicals toward a mixing chamber, the dispensing device is designed to be hand held, with the one or more containers, by a user.

Optionally, the one or more containers comprise two containers. Optionally, the one or more containers comprise a single container divided into a plurality of compartments. Optionally, the casing defines one or more recesses adapted to receive the containers within the casing. Optionally, the recesses are adapted to receive containers of a plurality of different sizes, operatively connected to the port. Optionally, the dispensing device with the one or more full containers, weighs less than 5 kilograms. Optionally, the suction unit comprises separate pumps for each of the chemicals. Optionally, the suction unit includes one or more sets of suction gears. Optionally, the suction unit pumps the chemicals out of the containers at different rates. Optionally, the chemicals pumped by the suction unit reach a pressure above 5 atmospheres. Optionally, the device includes one or more heaters adapted to heat the chemicals in the containers. Optionally, the device includes heaters adapted to heat the chemicals pumped from the containers. Optionally, the mixing chamber is included in the dispensing device.

Optionally, the mixing chamber is detachably attached to the casing.

Optionally, the device includes a nozzle through which the mixed chemicals are released to the environment. Optionally, the nozzle comprises a material to which foam does not adhere. Optionally, the walls of the nozzle are flexible. Optionally, the nozzle is usable over a plurality of separate foam generating sessions. Optionally, the compartments are substantially rigid. Optionally, the mixing chamber is defined by flexible walls.

Optionally, the mixing chamber is expanded by the pressure of streams of chemicals pumped from the containers. Optionally, the mixing chamber is expanded from a substantially zero volume when the suction unit is not operating to a larger volume, when the section unit is operating. Optionally, the device includes least one pressure valve along the path from the containers to the mixing chamber.

Optionally, the device includes at least one pusher adapted to push the chemicals in the at least one container toward an exit of the container.

There is further provided in accordance with some embodiments of the invention, a foam dispensing device, comprising a casing, a port adapted to receive one or more containers

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including a plurality of chemicals in a plurality of compartments; and a detachable foam mixing chamber, easily detachable from the casing without use of tools, in which chemicals from the plurality of compartments are mixed, the dispensing device with the one or more containers is hand held.

5           Optionally, substantially all portions of the dispensing device that come in contact with the chemicals after they are mixed are included in a single detachable element with the mixing chamber. Optionally, the device includes a heater for heating the chemicals in the compartments. Optionally, the device includes a motor which pumps the chemicals from the compartments to the mixing chamber.

10           There is further provided in accordance with some embodiments of the invention, a foam dispensing device, comprising a plurality of input tubes adapted to receive chemicals, a mixing chamber having at least one elastic wall and a flow inducer adapted to induce flow of the chemicals received from the input tubes into the mixing chamber, the mixing chamber has a first volume when the flow inducer is not operating, and a second, larger, volume when the  
15           flow inducer induces flow of the chemicals into the mixing chamber.

            Optionally, the plurality of input tubes receive chemicals from containers included in a casing of the dispensing device. Alternatively, the plurality of input tubes receive chemicals from containers not mounted on the dispensing device. Optionally, the flow inducer comprises a pump. Optionally, the pump comprises a gear pump. Optionally, the at least one elastic wall  
20           closes the path from the input tubes to the mixing chamber. Optionally, the mixing chamber has a large opening to the environment.

            There is further provided in accordance with some embodiments of the invention, a base for a foam dispensing device, comprising a niche for receiving the dispensing device, a battery charger adapted to charge a battery of the dispensing device while the dispensing  
25           device is in the niche, at least one compartment for receiving a container including a chemical used in generating foam by the dispensing device and a heater adapted to heat the contents of the container in the at least one compartment.

            Optionally, the base includes at least one storage compartment for receiving a chemical container, wherein the chemical in the container in the storage compartment is not  
30           substantially heated while in the storage compartment.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Particular exemplary embodiments of the invention will be described with reference to the following description of embodiments in conjunction with the figures, wherein identical

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structures, elements or parts which appear in more than one figure are generally labeled with a same or similar number in all the figures in which they appear, in which:

Fig. 1 is a schematic illustration of a foam generating and dispensing system, in accordance with an exemplary embodiment of the invention;

5 Fig. 2 is a cross-sectional view of a dispensing gun, in accordance with an exemplary embodiment of the invention;

Fig. 3 is a schematic view of elements forming a suction unit, in accordance with an exemplary embodiment of the invention;

10 Fig. 4 is a schematic view of the suction unit of Fig. 3 assembled together, in accordance with an exemplary embodiment of the invention;

Figs. 5A and 5B are cross-sectional views of an exit portion of the dispensing gun of Fig. 2, in accordance with an exemplary embodiment of the invention;

Fig. 6 is a schematic view of a nozzle of a dispensing gun, in accordance with another exemplary embodiment of the invention;

15 Fig. 7 is a schematic illustration of a dispensing system, in accordance with another exemplary embodiment of the invention; and

Fig. 8 is a schematic view of a stand for a foam dispensing gun, in accordance with an exemplary embodiment of the invention.

#### DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

20 Fig. 1 is a schematic illustration of a foam generating and dispensing system 100, in accordance with an exemplary embodiment of the invention. System 100 comprises a base 110 which includes a recess 112 sized and shaped to receive a hand-held foam dispensing gun 120. Optionally, a battery (not shown) of gun 120 is charged when the gun is properly placed in recess 112. Base 110 optionally further includes a plurality of recesses 130 adapted to  
25 receive chemical containers, and heat the containers while they are in the recesses. In an exemplary embodiment of the invention, recesses 130 host containers 132 of a chemical A, c.g., and containers 134 of a chemical B. In an exemplary embodiment of the invention, chemical A comprises a polymeric isocyanate or a fluorocarbon, while chemical B comprises polyols, catalyst or flame retardants. It is noted, however, that system 100 is not limited to use  
30 with any specific chemicals and has advantages which are useful for mixing many chemicals. Particularly, the materials from which system 100 is formed are optionally selected according to the chemicals being mixed. Alternatively or additionally, the size of containers 132 and 134 may be selected according to the specific chemicals used. For example, rather than using

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containers of same sizes, containers of different sizes may be used, according to the mixing ratio of the chemicals.

Optionally, a switch 140 is used to activate the heating in recesses 130. In some embodiments of the invention, the heating is applied to all the recesses 130. Alternatively, the heating is applied only to a single pair of recesses 130 which are known by the operator, such that the operator takes replacement containers from those recesses. The heating optionally brings the chemicals to an optimal temperature for improved mixing viscosity. Alternatively, the heating brings the chemicals to a temperature lower than optimal and the remaining temperature increase is completed within gun 120. In some embodiments of the invention, the containers 132 and 134 are heated in recesses 130 to a temperature which does not prevent the user from holding the containers and loading them into gun 120. Optionally, the heating in base 110 is controlled by a thermostat. Alternatively, the heating is performed, for simplicity, without a controller.

Gun 120 includes a housing 160 with a removable top end 162, which allows replacing containers 132 and 134 as described hereinbelow. Optionally, gun 120 includes a handle 164 for holding gun 120 and an activation trigger 166 on handle 164. In some embodiments of the invention, a stabilization structure 150 protrudes from the bottom side 168 of gun 120 at an opposite end from handle 164. When held by a user, structure 150 optionally rests on the user's arm, thus stabilizing gun 120 on the user's arm and allowing for accurate aiming of the foam released from the gun, while gun 120 is held with only one hand. In some embodiments of the invention, gun 120 weighs less than 5Kg, or even less than 3 Kg when containers 132 and 134 are full. In an exemplary embodiment of the invention, gun 120 has dimensions of about 50 X 18 X 8 centimeters.

In some embodiments of the invention, gun 120 includes a control panel 170 which allows a user to set various operation attributes of the gun. Alternatively or additionally, the operation attributes of gun 120 can be set from a control panel not on gun 120, for example a control panel on base 110, on a computer (not shown) connected to base 110 or on a remote control. Control panel 170 may include, for example, mixing ratios of the chemicals, the heating temperature and/or the desired operation rate. Alternatively or additionally to allowing the setting of operation attributes, control panel 170 displays the status of gun 120, such as the charging level of the battery and/or the remaining amount of chemicals in the containers.

Alternatively to using stabilizing structure 150, gun 120 may include a strap or a rigid bracelet which is used to connect the gun to the user's arm. Further alternatively or

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additionally, handle 164 is replaced by an enclave, a ring, a strap and/or any other holding and/or attachment mechanism. Gun 120 optionally has a structure that allows it to be easily balanced on the user's hand,

Fig. 2 is a cross-sectional view of gun 120, in accordance with an exemplary embodiment of the invention. Gun 120 includes a body section 202 adapted to receive  
5 containers 132 and 134. A plurality of heating elements 206 optionally surround containers 132 and/or 134 so as to heat the contents of the containers to an optimal temperature for foam generation. A suction unit 210 sucks the chemicals from containers 132 and 134 through  
10 channels 212 and 214, respectively. The chemicals are mixed and ejected through a nozzle 220. Optionally, the mixing of the chemicals is performed within a cavity defined in an exit unit 392 within suction unit 210. When gun 120 is operated, motor 260 optionally rotates a shaft 262, which in turn powers the suction, as described below with reference to Fig. 3.

In some embodiments of the invention, containers 132 and 134 have moving rear walls  
232 and 234, which are pushed by respective screws 226 and 228, so that sufficient chemical  
15 amounts are located within containers 132 and 134 adjacent channels 212 and 214. A screw motor 240 optionally actuates the movement of screws 226 and 228. The force applied by screw motor 240 to screws 226 and 228 is not intended to override the operation of suction unit 210, but rather only applies to the organization of the chemicals within containers 132 and 134. Screws 226 and 228 optionally achieve a relatively low pressure, while suction unit 210  
20 achieves a higher pressure. In some embodiments of the invention, a clutch mechanism (not shown) disconnects motor 140 from one or both of screws 226 and 228 when the force from the motor is not required in one or both of the containers. Optionally, screw motor 240 operates whenever suction unit 210 is operated. Alternatively, screw motor 240 operates only when suction unit 210 encounters problems in sucking sufficient material. Alternatively to  
25 using separate motors 240 and 260, a single motor is used to rotate both shaft 262 and screws 226 and 228.

Alternatively or additionally to using screw motor 240 and/or screws 226 and 228, other mechanisms for pushing the chemicals in containers 132 and 134 toward suction unit 210 may be used, such as one or more springs.

30 In some embodiments of the invention, gun 120 is powered by a battery 282. Alternatively or additionally, gun 120 is powered by a connection to an electrical socket.

Body section 202 may be planned to receive containers 132 and 134 of only a single size. Alternatively, body section 202 is adapted to receive containers 132 and 134 of a

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plurality of different sizes. Thus, the consumer can choose the container size to be used, according to the expected amount of foam he/she will require in the near future. It is noted, however, that even after containers 132 and 134 are opened, there is no problem leaving them unused for a few days and they can be used again immediately thereafter.

5 Fig. 3 is a schematic view of the elements forming suction unit 210, in accordance with an exemplary embodiment of the invention. Suction unit 210 includes three boards 310, 312 and 314, which hold the various moving elements of suction unit 210. Shaft 262 optionally passes through holes 316 and 318 in boards 310 and 312 to a first set of suction gears 322 and 324, which suck a chemical from container 134. Gears 352 and 354 between  
10 boards 310 and 312 transfer the rotation force of shaft 262 to a second set of suction gears 362 and 364, which suck a chemical from container 132. In some embodiments of the invention, the ratio between gears 352 and 354 defines the ratio of the volume of the chemicals sucked from containers 132 and 134.

Suction gears 322 and 324, as well as suction gears 362 and 364, optionally operate in  
15 accordance with the operation methods of gear metering pumps known in the art. Optionally, the suction gears have a relatively high accuracy with an error level of up to about 2-5%, for example 3%, of the desired sucked quantities. The chemicals from containers 132 and 134 enter suction unit 210 through channels 372 and 374 optionally carved in board 314. From channels 372 and 374, the chemicals pass through holes 382 and 384 into a mixing chamber  
20 defined between a central unit 390 and exit unit 392, which includes nozzle 220.

Fig. 4 is a schematic cut-open view of suction unit 210 assembled together, in accordance with an exemplary embodiment of the invention. In Fig. 4, central unit 390 is shown in place within boards 312 and 314. An internal piece 393 sits within central unit 390 and attaches to exit unit 392. In addition, Fig. 4 shows the path leading from hole 382, through  
25 a bore 389, to a channel between internal piece 393 and exit unit 392, as discussed below with reference to Fig. 5A.

Fig. 5A is a cross-sectional view of central unit 390, internal piece 393 and exit unit 392, in accordance with an exemplary embodiment of the invention. During operation, the chemical flow in bore 389 enters a narrow channel 516 passing within exit unit 392. Similarly,  
30 the chemical from the other container flows into a narrow channel 514, within exit unit 392. The chemical flows exit narrow channels 514 and 516 near a tip 510 of internal piece 393, and press against a valve defined by opposite lips 508 of exit unit 392. The pressure on lips 508, due to high pressure from the pumps, causes lips 508 to separate, as shown in Fig. 5B, which

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is a variation of Fig. 5A in which the pressure of the chemicals form at least a portion of a mixing chamber 598. The chemicals from narrow channels 514 and 516 enter mixing chamber 598 and mix together. From mixing chamber 598, the mixed chemicals flow out nozzle 220 into their desired packing location according to the direction of gun 120. When suction gears 322 and 324 stop their operation, the pressure on lips 508 stops and they return back into their closed position (Fig. 5A), preventing settling of foam within mixing chamber 598.

Lips 508 serve as flexible walls which define mixing chamber 598, when the walls are expanded by the pressure of the chemicals exiting narrow channels 514 and 516. A potential advantage of using a flexible wall is that it reduces the amount of mixed chemicals that can settle within chamber 598 and hence the amount of foam remnants hardening in chamber 598 is small. In some embodiments of the invention, exit unit 392 may be used for a plurality of foam dispensing sessions, which occur at different times separated by hours, days or even weeks. In addition, lips 508 serve as a valve which prevents dripping of material when suction unit 210 stops operating.

During the pumping of the chemicals, mixing chamber 598 is open to the environment. Optionally, an entire side of the chamber is open to the environment. Alternatively or additionally, at least 10% or even 20% of the circumference of the chamber is open to the environment. Having chamber 598 open to the environment reduces the possibility of settling of foam remnants within the chamber. In addition, having the chamber open to the environment allows cleaning the mixing chamber from foam remnants. The mixing of the chemicals is optionally performed as they flow through the mixing chamber.

In some embodiments of the invention, when the chemicals are not pumped out of the containers, the volume of mixing chamber 598 is substantially zero, due to the return of lips 508 back into their rest position (Fig. 5A). Alternatively, the closing of lips 508 closes a portion of chamber 598 nearer channels 514 and 516. The remaining portion of chamber 598 is open to the environment. Optionally, any settling of foam in nozzle 220 can be easily removed by pressing the walls of nozzle 220 by a human operator. As shown in Figs. 5A and 5B, the streams in narrow channels 514 and 516 are not directed at lips 508 but rather at tip 510. Therefore, a relatively high chemical pressure is required in order to open a passageway to mixing chamber 598. In other embodiments of the invention narrow channels 514 and 516 are more directly pointed at lips 508, thus reducing the pressure level required in order to open the lips.

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In some embodiments of the invention, the high pressure of the chemical streams has a double purpose. On the one hand, the pressure opens mixing chamber 598 and the path out of suction unit 210 to nozzle 220. On the other hand, the pressure is used in achieving a high quality mix of the chemicals.

5        Nozzle 220 is optionally formed of a flexible but durable material, such that the walls of nozzle 220 can be pressed together in order to remove foam remnants that settled in the nozzle, if such remnants remain. The pressing generally grinds the foam remnants or at least causes them to detach from the nozzle. Alternatively or additionally, nozzle 220 is formed of a material to which foam remnants do not stick or at least have a relatively weak bonding. In an  
10        exemplary embodiment of the invention, nozzle 220 is formed of Teflon, delarin and/or polypropylene. In other embodiments, polypropylene, polyethylene and/or silicon are used.

      Nozzle 220 is optionally flared in order to minimize the settling of the mixed chemicals on walls of the nozzle. In some embodiments of the invention, nozzle 220 has two  
15        parallel relatively rigid walls 398 (Fig. 3), connected by two more flexible walls. When pressed on, the flexible walls move and collapse, while the rigid walls compress the foam remnants. In some embodiments of the invention, flexible walls 396 (Fig. 3) have a central folding line 397 (Fig. 3). Alternatively, nozzle 220 has a circular and/or conical shape. Nozzle  
20        220 has an expanding shape toward its outlet to the environment, so that it is relatively easy to remove foam remnants from the nozzle (e.g., by allowing simple access with a screwdriver or other tool) and hardening foam remnants are not caught tightly between the walls of the nozzle. Optionally, nozzle 220 does not include corners and/or enclaves in which foam remnants can settle. Nozzle 220 optionally has a length and/or width sufficiently large to receive the fingers of a user and allow the user to press against the walls in order to remove foam remnants therefrom.

25        In some embodiments of the invention, exit unit 392 is planned to allow fast release of exit unit 392 from central unit 390 and/or to allow fast connection of exit unit 392 to central unit 390. Alternatively or additionally, exit unit 392 and central unit 390 are designed to allow their fast connection and/or release from and to the remaining portion of suction unit 210. Central unit 390 and/or exit unit 392 are optionally easily replaced, when necessary, for  
30        example due to clogging by settlement of foam remnants.

      It is noted that, in some embodiments of the invention, the chemicals from containers 132 and 134 are mixed only in exit unit 392, such that foam remnants can settle only within these easily replaced pieces. As lips 508 serve as valves which only allow passage of the



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chemicals when the chemicals are provided in relatively high pressure streams, the mixed chemicals cannot backflow into suction unit 210. Typically, after each 5-10 uses and/or when the operation is problematic (e.g., the mix is not good, the stream is weak), exit unit 392 is replaced. In some embodiments of the invention, the mixed chemicals also touch the tip 510 of internal piece 393. Optionally, in these embodiments, internal piece 393 is also easily replaceable, for example every 10-20 uses. Alternatively, chamber 598 is defined closer to nozzle 220, so that the mixed chemicals only touch portions of exit unit 392, which is easily replaceable.

In some embodiments of the invention, the chemicals are provided by suction unit 210 at a high pressure, such as between 6-10 atmospheres (e.g., 6.079-10.13 bar), so as to achieve a smooth mix of the chemicals.

Heaters 206 are optionally controlled to achieve a desired chemical heat of the contents of containers 132 and/or 134, such as between about 50-60°. Alternatively, for simplicity, heaters 206 are not controlled and perform the heating according to a predetermined operation pattern and/or the heat transfer characteristics of gun 120. For example, heaters 206 may be operated periodically and/or whenever suction unit 210 is operated. Heaters 206 optionally comprise twisted wire heaters, as is known in the art. Alternatively, other heating apparatus may be used, such as PTC heaters and/or heating rods. In some embodiments of the invention, heaters 206 range along the entire length of body section 202, so as to heat all the material in containers 132 and 134. Alternatively, heaters 206 range only along a portion of body section 202, for example the portion closer to suction unit 210. Optionally, heaters 206 cover substantially the entire circumference of containers 132 and 134, along the length of the containers that they cover. Alternatively, heaters 206 cover only a portion of the circumference of containers 132 and 134, as required to achieve a desired temperature. For example, for simplicity, in some embodiments of the invention, the side from which containers 132 and 134 are inserted into body section 202 is not covered by heater 206. Optionally, the containers are designed to transfer the heat according to the positions of the heaters in gun 120 and/or recesses 130.

The amount of material sucked from each container is optionally controlled by the rate of rotation of the sets of suction gears 322 and 324 and 362 and 364. Hence, the ratios of the mixed materials is defined by the ratio between the sizes of gears 352 and 354. Different chemicals may require different mixing ratios. In some embodiments of the invention, a customer can purchase dispensing system 100 with a plurality of suction units 210 which

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differ substantially only in the ratios between the radiuses of gears 352 and 354. Optionally, suction units 210 are easily replaceable according to the customer's needs. For example, a first suction unit 210 may be used for achieving a rigid foam for packaging computers, while a second suction unit 210 is used for a more soft packaging, for example for glass dishes. The different suction units 210 may be used with different chemicals or with same chemicals. Alternatively to the customer replacing suction units 210, the replacement is performed by a service station of a supplier of system 100, where suction units 120 or only gears 352 and 354 are replaced.

Fig. 6 is a schematic view of a nozzle 600 of a dispensing gun, in accordance with another exemplary embodiment of the invention. A body portion 602 of the dispensing gun includes two outlets 604 which separately provide streams of the chemicals, optionally of high pressure as discussed above. The streams are combined within nozzle 600 and are provided through an outlet 606. Nozzle 600 is optionally easily connected body portion 602 so as to allow easy and fast replacement of the nozzle. In some embodiments of the invention, body portion 602 includes protruding plates 610, which receive compatible protrusions 612. Optionally, nozzle 600 is attached to body portion 602 by bringing the nozzle at a small angle to the proximity of plates 610 and rotating the nozzle so that protrusions 612 move into the handles. Alternatively, the attachment is performed by squeezing nozzle 600 so that it passes into plates 610.

Alternatively to using passive nozzles 600, nozzles which include suction unit 210 may be used. Thus, replacement of suction unit 210 for different types of foams can be made simple.

Alternatively to providing a mixing chamber 598 in a nozzle connected to the dispensing gun, in some embodiments of the invention, the dispensing gun provides two separate streams of the different chemicals. A mixing chamber is placed in a box to be packaged and the separate streams are directed at this mixing chamber. The mixing chamber may include a cheap disposable unit, such as a bag.

Fig. 7 is a schematic illustration of a dispensing system 700, in accordance with another exemplary embodiment of the invention. In system 700, the chemicals are held in containers mounted on the gun and not in closed compartments within the gun. Dispensing system 700 comprises a dispensing gun 720 having a port 725 to which a container 701 is connected. Container 701 is optionally divided into two separate compartments 721 and 722, each of which containing a separate chemical. Compartments 721 and 722 may be of the same

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size or may have different sizes. In an exemplary embodiment of the invention, the ratio of the sizes of compartments 721 and 722 is equal to the mix ratio of the materials they contain when they mix into foam. Thus, both the compartments of container 701 empty out at substantially the same time. It is noted that the orientation of container 701 and port 725 is such that the contents of the container flow down into gun 720 without the need for a pushing mechanism as in the gun of Fig. 2. Levers 709 are optionally used to release container 701 for replacement.

When a trigger 706 is pressed, a valve 707 is opened, and the chemicals from container 701 are allowed to flow through separate channels 702 and 717 to a mixing chamber 704. It is noted that valve 707 may be close to port 725 and remote from mixing chamber 704 as shown in Fig. 7, or valve 707 may be close to mixing chamber 704. Release levers 708 allow fast removal of mixing chamber 708 and replacement with a new mixing chamber. Heaters 703 are optionally used to heat the chemicals to a desired mixing temperature. System 700 is optionally powered by an electrical cord connection 705. Alternatively or additionally, system 700 may be powered by a chargeable or non-chargeable battery.

Optionally, a piston 710 is used to increase the flow of the chemicals toward mix chamber 704. Alternatively or additionally, a suction unit, as described above with reference to Fig. 3, may be used in order to control the flow. It is noted, however, that in some embodiments of the invention, suction is not used and the chemical flow is achieved by the pushing of piston 710 and/or by gravity.

Alternatively to system 700 using a single container 701 having two separate compartments, system 700 may include two separate containers.

Fig. 8 is a schematic illustration of a stand 800 for use with foam dispensing gun 120, in accordance with an exemplary embodiment of the invention. Stand 800 may be used to fill packaging bags 810 by dispensing gun 120, instead of using gun 120 to directly place the foam in a package. Bags 110 optionally include filling ports which are adapted to fit on a compatible reception port on the bottom side of an arm 820. Above the reception port, arm 820 includes an aperture and/or base which firmly receives gun 120. In some embodiments of the invention, bags 810 are foldable as shown in a bag pile 816. In some embodiments of the invention, the chemical mixing occurs in the bags. Alternatively, the mixing occurs in a mixing chamber of gun 120.

It will be appreciated that the above described methods may be varied in many ways. It should also be appreciated that the above described description of methods and apparatus are

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to be interpreted as including apparatus for carrying out the methods and methods of using the apparatus.

The present invention has been described using non-limiting detailed descriptions of embodiments thereof that are provided by way of example and are not intended to limit the scope of the invention. For example, in addition to, or instead of, lips 508, separate pressure valves may be placed along the path to the mixing chamber in order to prevent back flow and/or operation at lower pressures than suitable. It should be understood that features and/or steps described with respect to one embodiment may be used with other embodiments and that not all embodiments of the invention have all of the features and/or steps shown in a particular figure or described with respect to one of the embodiments. Variations of embodiments described will occur to persons of the art.

It is noted that some of the above described embodiments may describe the best mode contemplated by the inventors and therefore may include structure, acts or details of structures and acts that may not be essential to the invention and which are described as examples. Structure and acts described herein are replaceable by equivalents which perform the same function, even if the structure or acts are different, as known in the art. Therefore, the scope of the invention is limited only by the elements and limitations as used in the claims. When used in the following claims, the terms "comprise", "include", "have" and their conjugates mean "including but not limited to".

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## CLAIMS

1. A foam dispensing device, comprising:  
a casing;  
5 a port adapted to receive one or more containers including a plurality of chemicals in a plurality of compartments; and  
a suction unit adapted to pump the chemicals from the compartments and direct the chemicals toward a mixing chamber,  
wherein the dispensing device is designed to be hand held, with the one or more  
10 containers, by a user.
2. A device according to claim 1, wherein the one or more containers comprise two containers.
- 15 3. A device according to claim 1, wherein the one or more containers comprise a single container divided into a plurality of compartments.
4. A device according to claim 1, wherein the casing defines one or more recesses adapted to receive the containers within the casing.
- 20 5. A device according to claim 1, wherein the recesses are adapted to receive containers of a plurality of different sizes, operatively connected to the port.
6. A device according to claim 1, wherein the dispensing device with the one or more full  
25 containers, weighs less than 5 kilograms.
7. A device according to claim 1, wherein the suction unit comprises separate pumps for each of the chemicals.
- 30 8. A device according to claim 1, wherein the suction unit includes one or more sets of suction gears.

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9. A device according to claim 1, wherein the suction unit pumps the chemicals out of the containers at different rates.
10. A device according to claim 1, wherein the chemicals pumped by the suction unit reach  
5 a pressure above 5 atmospheres.
11. A device according to claim 1, comprising one or more heaters adapted to heat the chemicals in the containers.
- 10 12. A device according to claim 1, comprising heaters adapted to heat the chemicals pumped from the containers.
13. A device according to claim 1, wherein the mixing chamber is included in the dispensing device.  
15
14. A device according to claim 1, wherein the mixing chamber is detachably attached to the casing.
15. A device according to claim 1, comprising a nozzle through which the mixed  
20 chemicals are released to the environment.
16. A device according to claim 15, wherein the nozzle comprises a material to which foam does not substantially adhere.
- 25 17. A device according to claim 15, wherein the walls of the nozzle are flexible.
18. A device according to claim 15, wherein the nozzle is usable over a plurality of separate foam generating sessions.
- 30 19. A device according to claim 1, wherein the compartments are substantially rigid.
20. A device according to claim 1, wherein the mixing chamber is defined by flexible walls.

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21. A device according to claim 1, wherein the mixing chamber is expanded by the pressure of streams of chemicals pumped from the containers.
- 5 22. A device according to claim 21, wherein the mixing chamber is expanded from a substantially zero volume when the suction unit is not operating to a larger volume, when the section unit is operating.
23. A device according to claim 1, comprising at least one pressure valve along the path  
10 from the containers to the mixing chamber.
24. A device according to claim 1, comprising at least one pusher adapted to push the chemicals in the at least one container toward an exit of the container.
- 15 25. A foam dispensing device, comprising:  
a casing;  
a port adapted to receive one or more containers including a plurality of chemicals in a plurality of compartments; and  
a detachable foam mixing chamber, easily detachable from the casing without use of  
20 tools, in which chemicals from the plurality of compartments are mixed,  
wherein the dispensing device with the one or more containers is hand held.
26. A device according to claim 25, wherein substantially all portions of the dispensing device that come in contact with the chemicals after they are mixed are included in a single  
25 detachable element with the mixing chamber.
27. A device according to claim 25, comprising a heater for heating the chemicals in the compartments.
- 30 28. A device according to claim 25, comprising a motor which pumps the chemicals from the compartments to the mixing chamber.
29. A foam dispensing device, comprising:

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a plurality of input tubes adapted to receive chemicals;  
a mixing chamber having at least one elastic wall; and  
a flow inducer adapted to induce flow of the chemicals received from the input tubes into the mixing chamber,

5        wherein the mixing chamber has a first volume when the flow inducer is not operating, and a second, larger, volume when the flow inducer induces flow of the chemicals into the mixing chamber.

30.    A device according to claim 29, wherein the plurality of input tubes receive chemicals  
10    from containers included in a casing of the dispensing device.

31.    A device according to claim 29, wherein the plurality of input tubes receive chemicals from containers not mounted on the dispensing device.

15    32.    A device according to claim 29, wherein the flow inducer comprises a pump.

33.    A device according to claim 29, wherein the pump comprises a gear pump.

34.    A device according to claim 29, wherein the at least one elastic wall closes the path  
20    from the input tubes to the mixing chamber.

35.    A device according to claim 29, wherein the mixing chamber has a large opening to the environment.

25    36.    A base for a foam dispensing device, comprising:  
a niche for receiving the dispensing device;  
a battery charger adapted to charge a battery of the dispensing device while the dispensing device is in the niche;  
at least one compartment for receiving a container including a chemical used in  
30    generating foam by the dispensing device; and  
a heater adapted to heat the contents of the container in the at least one compartment.



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37. A base according to claim 36, comprising at least one storage compartment for receiving a chemical container, wherein the chemical in the container in the storage compartment is not substantially heated while in the storage compartment.

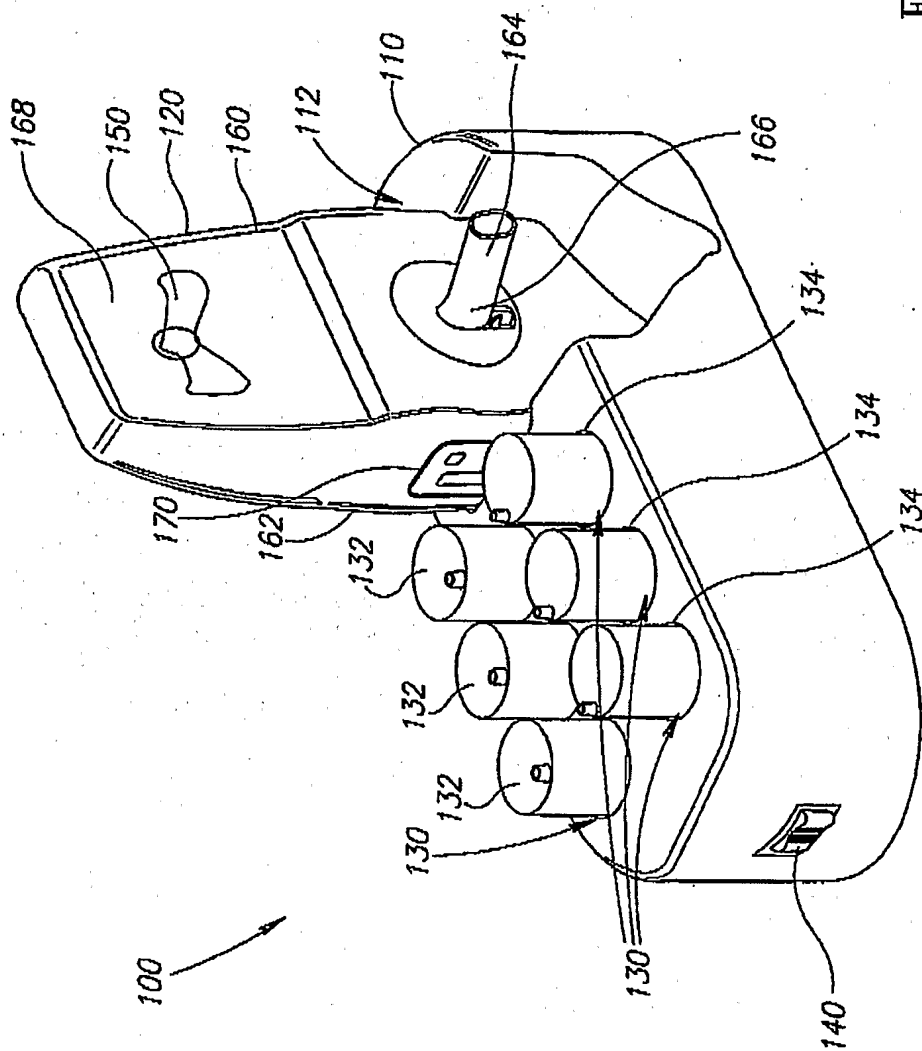


FIG. 1

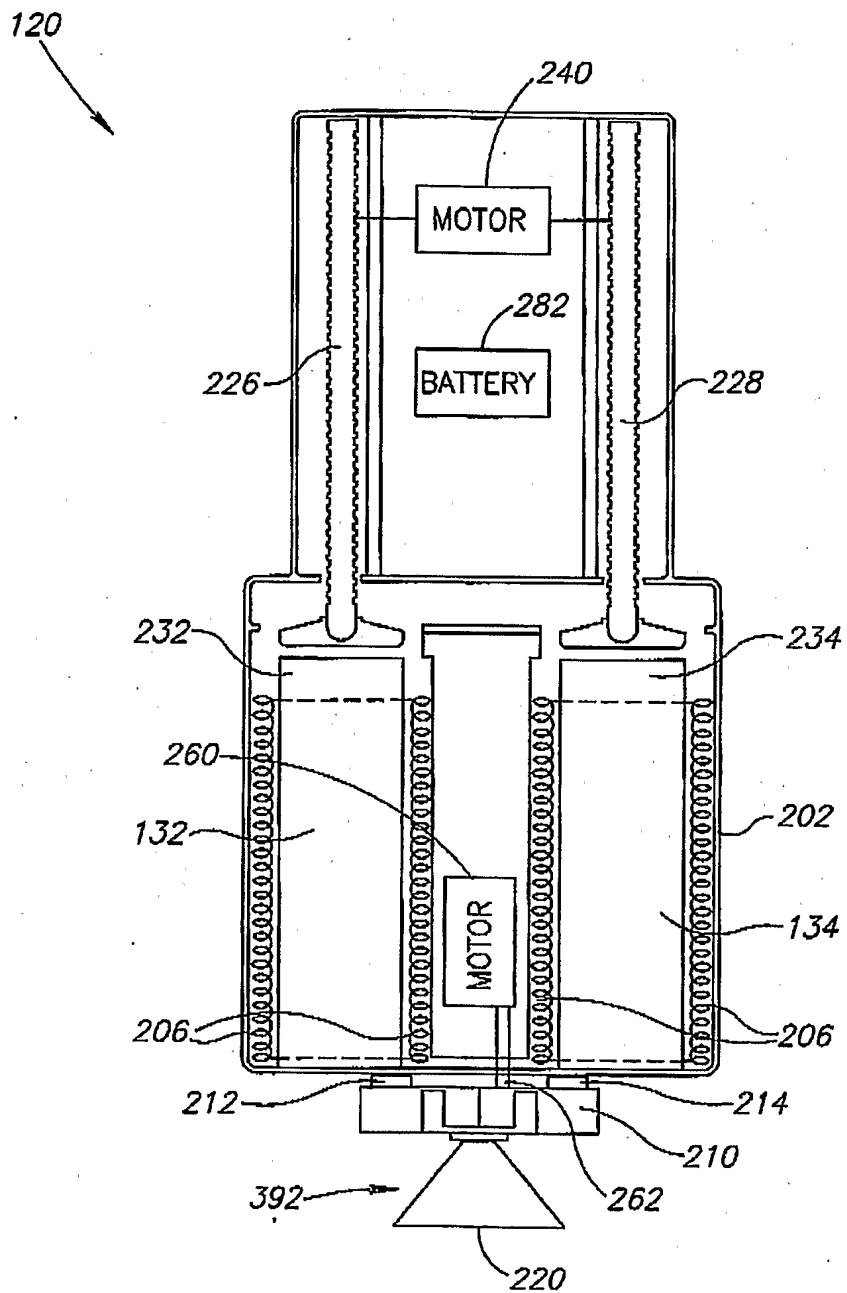


FIG.2

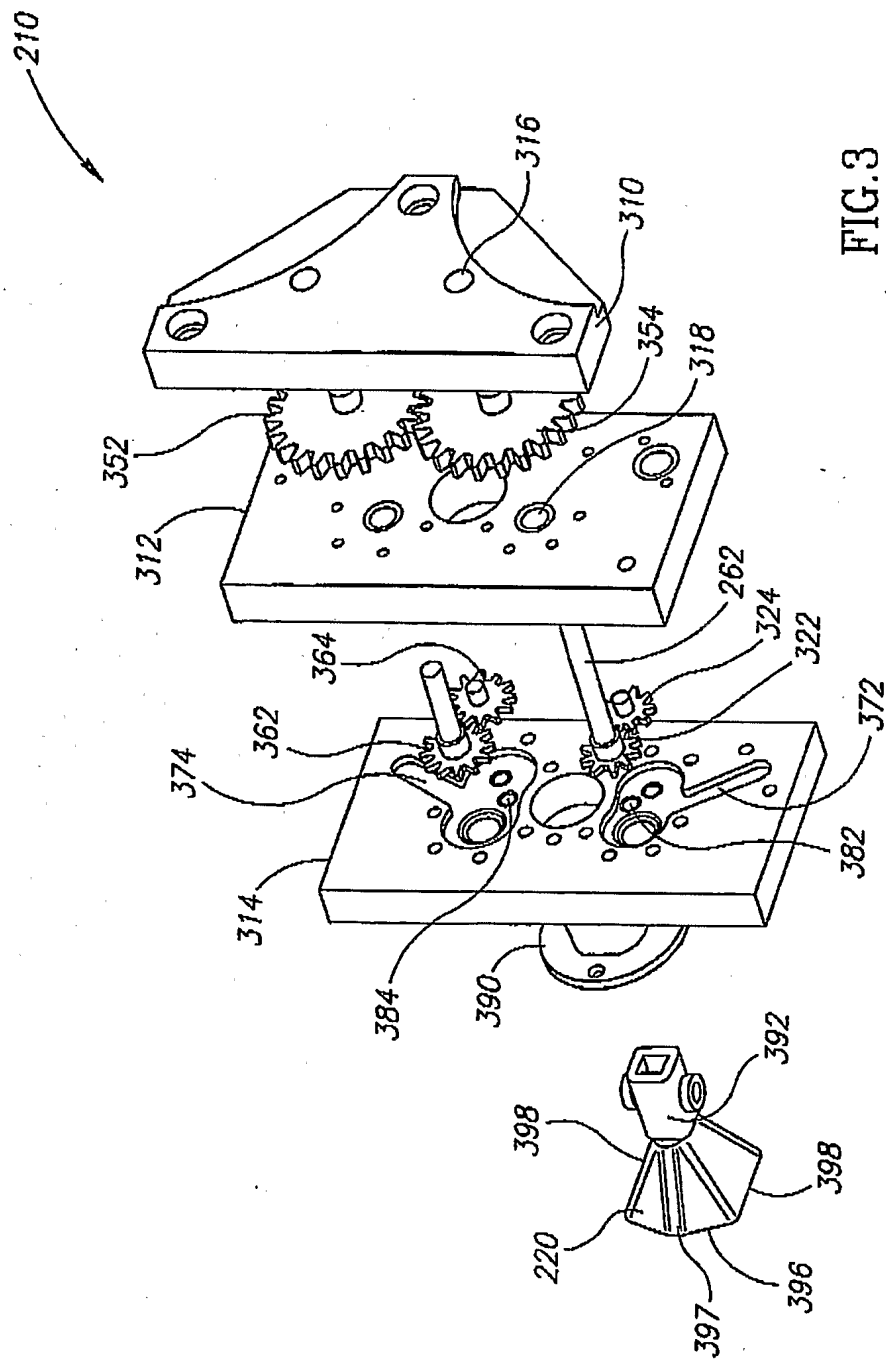


FIG. 3

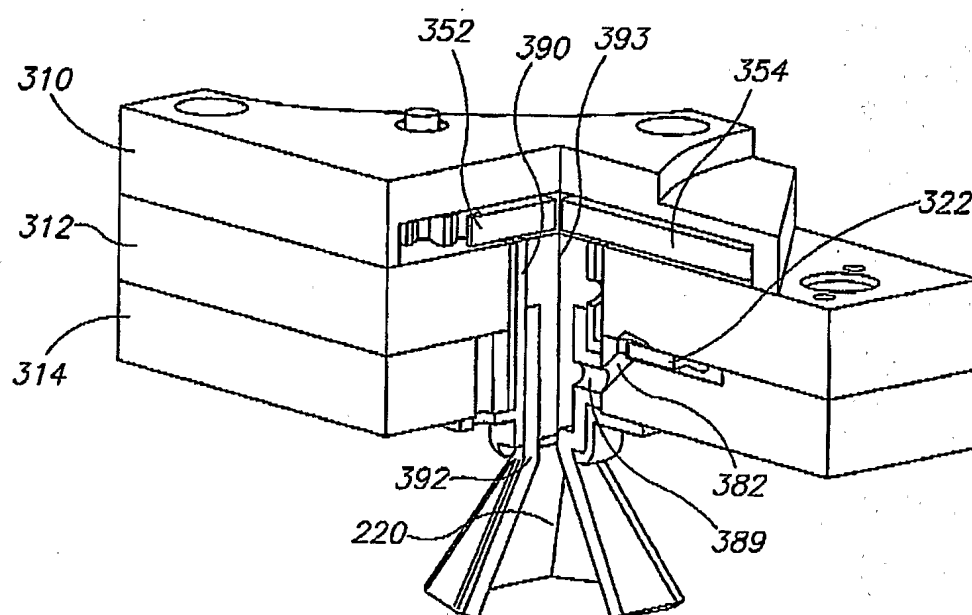


FIG. 4

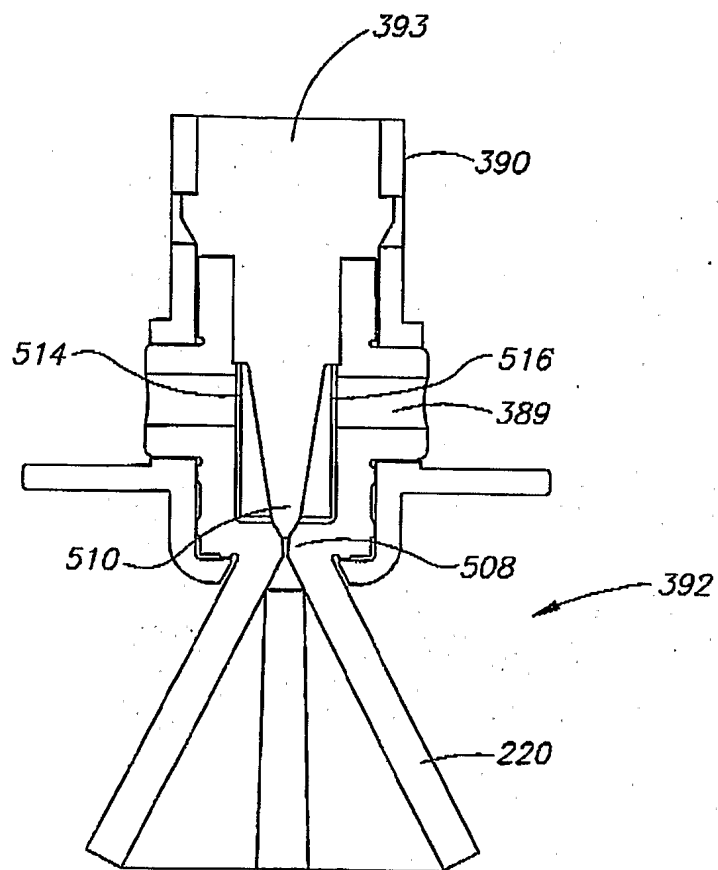


FIG. 5A

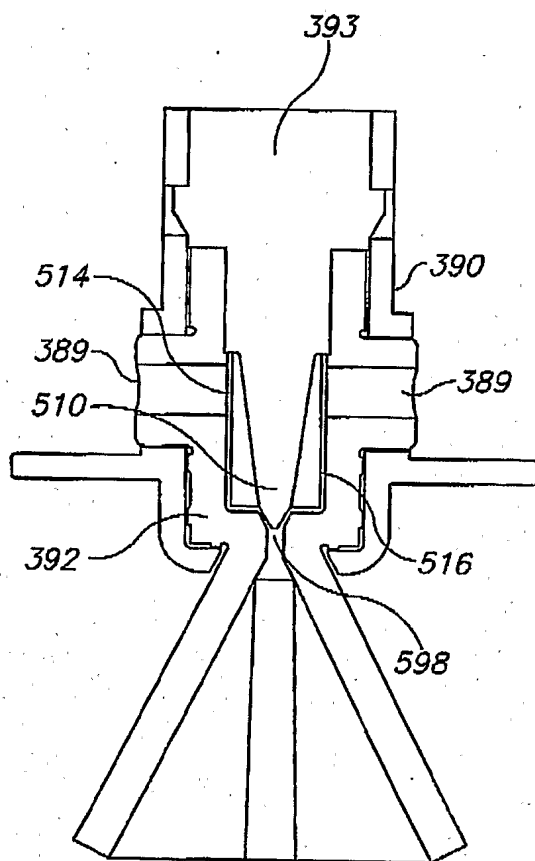


FIG.5B

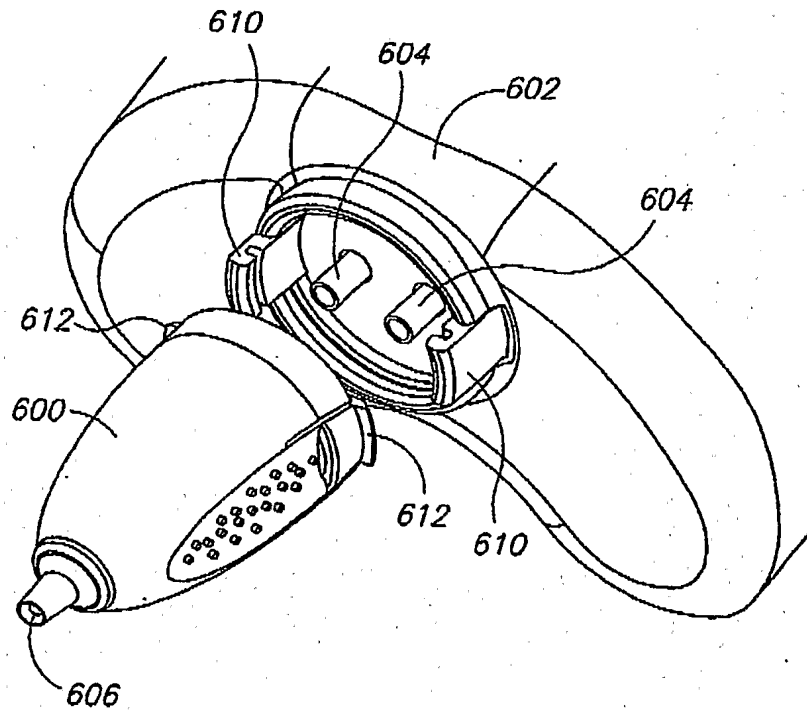


FIG. 6



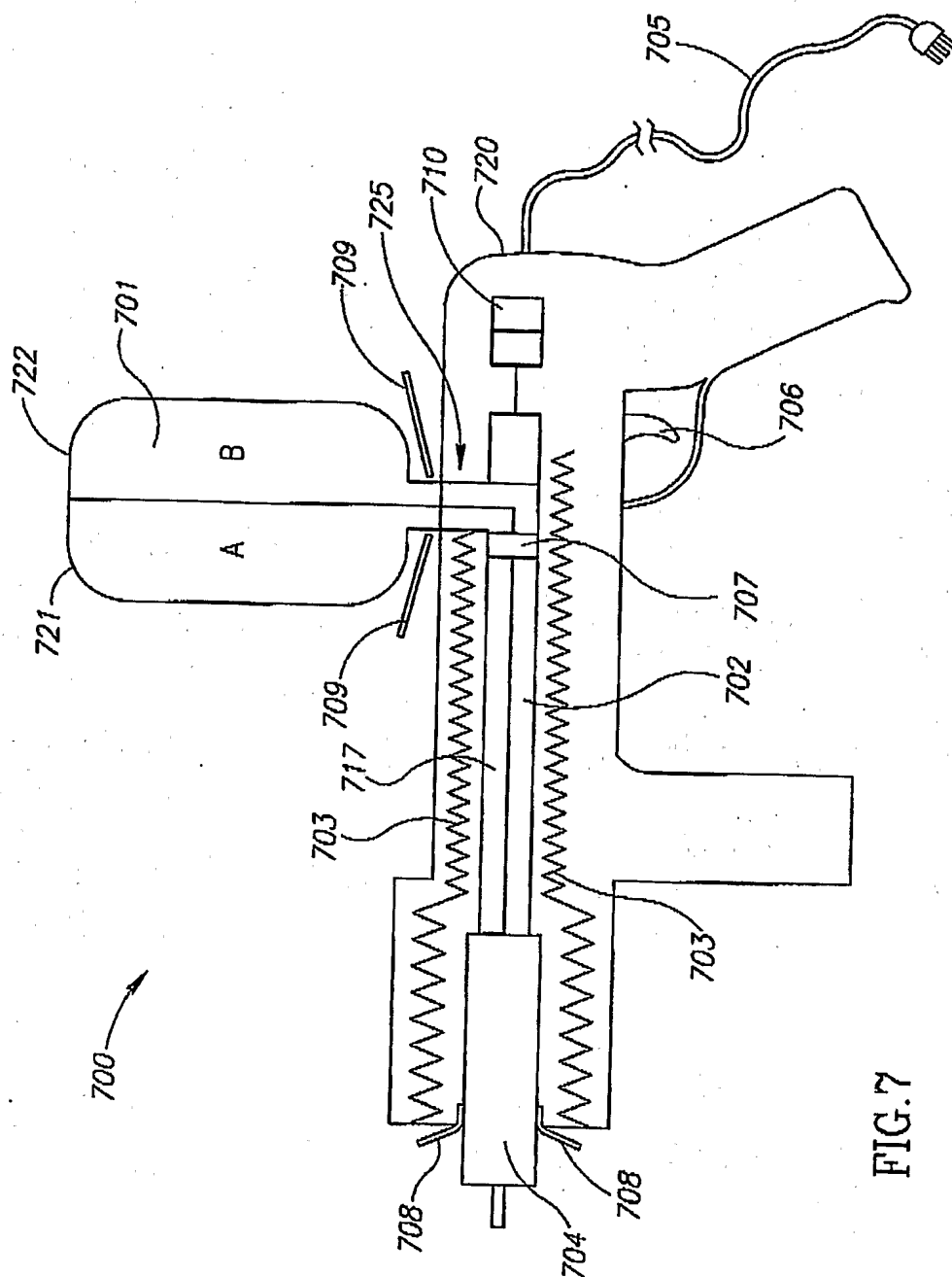


FIG. 7

